FREQUENCY RESHAPED QUADRATIC CONTROL OF A BELT-DRIVEN ROBOT

Kok-Meng Lee, Associate Professor
Chad Rutherford, Graduate Student Assistant

The George W. Woodruff School of Mechanical Engineering
Georgia Institute of Technology
Atlanta, GA 30332-0405
Tel: (404)894-7402, Fax: (404)894-9342
email: kokmeng.lee@me.gatech.edu

ABSTRACT

Belt driven robots are desirable for many industrial applications that require a fast response for a relatively large amount of travel in a system. A belt drive is a simple, light weight device that is also cost effective in comparison to other methods of arm positioning. The tradeoff of a belt driven robot is the need for an effective control strategy to reject time-varying disturbances due to the belt stiffness variation and the presence of resonance which could be excited by disturbances of high frequencies. In this paper, we present the dynamic model and control of a low-cost belt-driven robot.

We present here the modeling and control of a belt-driven robot developed at Georgia Tech as shown in Fig. 1. The belt-driven robot is a low-cost human-level performance robot, specifically meant to meet or exceed the performance of a human taking shrink wrapped packages off of a conveyor and placing them in a basket for delivery. Therefore, such attributes as speed and accuracy are dictated by the level of performance a human can achieve. The control design for the IIBM presents a challenge in that a control system for the belt driven axis must be designed by using a low-order plant model that is robust enough to variations in both the parameter changes and the un-modeled high frequency dynamics. For these reasons, we investigate the use of frequency reshaped linear quadratic (FRLQ) control in the development of a low-cost IIBM, which combines the time domain linear quadratic optimal control design with classical frequency response methods.

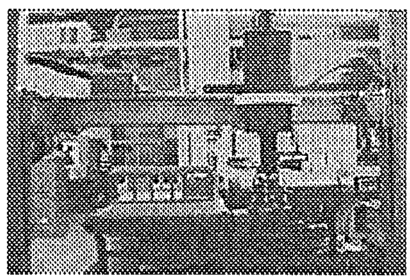

Fig. 1 Intelligent Integrated Belt Manipulator (IIBM)

The control strategy, based on FRLQ method, has been implemented on the first axis of an IIBM. The performance has been evaluated analytically by simulation and experimentally, the results of which are compared against a well-tuned PD controller. Experimental implementation has demonstrated that the frequency reshaped linear quadratic control has a potential to significantly improve the performance of the belt-driven robot.